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Study of Various Properties of E-Glass Fiber Polyester with Titanium Dioxide Hybrid Composite Materials

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***Abstract* - This venture work depicts the improvement and portrayal of another arrangement of crossbreed polymer composites comprising of glass fiber support, unsaturated polyester tar, and TiO2 particulate fillers. The recently evolved composites are described concerning their mechanical, warm and compound qualities. Analyses are done to examine the impact of fiber substance and consistent particulate substance on the composite quality of this glass fiber unsaturated polyester-based cross breed composites. The outcome uncovers that the rigidity is expanded with the expansion in fiber and consistent particulate stacking up to 40% and after that, it is diminished. The level of progress sway quality is expanded with the expansion in fiber and steady particulate stacking up to 40% and after that, it is diminished. The substance opposition and Hardness are expanded with the expansion of particulate filler (TiO2) to the polymer composites.**

Keywords: E-glass, Titanium Di Oxide, Fiber, Reinforcement, plastics, Hybrid, Composite materials.

I. INTRODUCTION

The composite materials progress is related to design and manufacturing technologies are the most important advances in the history of materials. Numerous composites additionally show extraordinary protection from high-temperature consumption and oxidation and wear. These one of a kind quality give the mechanical designer configuration chances unrealistic with regular solid (unreinforced) materials. Composites innovation additionally utilizes a whole class of strong materials, earthenware production in applications for which solid adaptations are unsuited as a result of their incredible quality dissipate Further, many assembling forms for composites are all around adjusted to the creation of huge, complex structures, which permits combination of parts, lessening producing costs. Fiber-strengthened plastics have been broadly utilized for assembling airplane and shuttle auxiliary parts in light of their specific mechanical and physical properties, for example, high explicit quality and high explicit firmness. Composites are several functions materials with extraordinary mechanical and physical properties that can be tailored to meet the requirements of a particular application. Another application of fiber reinforced polymer composites (particularly glass fiber reinforced plastics) is the electronics industry, in which they are used to make printed circuit boards.

1.1 Composite Materials

Composite materials are building materials created utilizing in any event two constituent materials that stay disengaged and indisputable on a doubtlessly noticeable level while forming a single fragment. There are two orders of constituent materials: cross section and fortress. The cross section material incorporates and supports the stronghold materials by keeping up their relative positions.

The fortresses give their outstanding mechanical and physical properties to improve the cross section properties. The objective is to misuse the unparalleled properties of the two materials without choosing the inadequacy of either. It is exactly when the constituent stages have in a general sense unprecedented physical property and thusly, the composite properties are unmistakably not exactly equivalent to the constituent properties. The essential elements of the grid are to move worries between the fortifying filaments/particles and to shield them from mechanical and additionally natural harm while the nearness of strands / particles in a composite improves its mechanical properties, for example, quality, firmness, and so forth. Composite methods material having at least two unmistakable constituent materials or stages.

1.2 Mechanics

The physical properties of composite materials are commonly not isotropic (free of heading of applied power) in nature, yet rather are regularly orthotropic (distinctive relying upon the bearing of the applied power or burden). For example, the firmness of a composite board will frequently rely on the direction of the applied powers and additionally minutes. Board firmness is additionally subject to the plan of the board. For example, the fiber support and network utilized the strategy for board construct, thermo set versus

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thermoplastic, kind of weave, and direction of fiber pivot to the essential power.

Interestingly, isotropic materials (for instance, aluminum or steel), in standard fashioned structures, ordinarily have a similar firmness paying little heed to the directional direction of the applied powers and additionally minutes. The connection between powers/minutes and strains/ebbs and flows for an isotropic material can be depicted with the accompanying material properties: Young's Modulus, the Shear Modulus and the Poisson's proportion, in generally straightforward scientific connections. For the anisotropic material, it requires the science of a second request tensor and up to 21 material property constants. For the unique instance of symmetrical isotropy, there are three diverse material property constants for every one of Young's Modulus, Shear Modulus and Poisson's proportion—a sum of 9 constants to portray the connection between powers/minutes and strains/ebbs and flows.

Procedures that exploit the anisotropic properties of the materials incorporate mortise and Tenon joints (in normal composites, for example, wood) and Pi Joints in engineered composites.

1.3 Making a Composite

Most composites are comprised of only two materials. One material (the grid or folio) encompasses and ties together a bunch of strands or parts of a lot more grounded material (the fortification). On account of mud blocks, the two jobs are taken by the mud and the straw; in concrete, by the concrete and the total; in a bit of wood, by the cellulose and the lignin. In fiberglass, the support is given by fine strings or filaments of glass, regularly woven into a kind of fabric, and the framework is a plastic.

The strings of glass in fiberglass are solid under pressure yet they are additionally weak and will snap whenever bowed strongly. The lattice not just holds the filaments together, it likewise shields them from harm by sharing any worry among them. The grid is sufficiently delicate to be molded with devices, and can be mollified by reasonable solvents to permit fixes to be made. Any twisting of a sheet of fiberglass fundamentally extends a portion of the glass strands, and they can oppose this, so even a slim sheet is solid. It is likewise very light, which is a bit of leeway in numerous applications. Over ongoing decades numerous new composites have been grown, some with truly significant properties. Via cautiously picking the support, the grid, and the assembling procedure that unites them, designers can tailor the properties to meet explicit prerequisites. They can, for instance, make the composite sheet extremely solid one way by adjusting the filaments that way, yet more fragile toward another path where quality isn't so significant. They can likewise choose properties, for example, protection from warmth, synthetic substances, and enduring by picking a fitting lattice material.

1.4 Choosing Materials for the Matrix

For the lattice, numerous advanced composites utilize thermosetting or thermo mellowing plastics (additionally called saps). (The utilization of plastics in the framework clarifies the name 'strengthened plastics' generally given to composites). The plastics are polymers that hold the fortification together and help to decide the physical properties of the final result. Thermosetting plastics are fluid when arranged however solidify and get inflexible (ie, they fix) when they are warmed. The setting procedure is irreversible, so these materials don't turn out to be delicate under high temperatures. These plastics additionally oppose wear and assault by synthetic compounds making them entirely solid, in any event, when presented to extraordinary situations. Thermo relaxing plastics, as the name suggests, are hard at low temperatures yet mollify when they are warmed. In spite of the fact that they are less usually utilized than thermosetting plastics they do have a few favorable circumstances, for example, more noteworthy break sturdiness, the long time span of usability of the crude material, limit with regards to reusing and a cleaner, more secure work environment since natural solvents are not required for the solidifying procedure. Pottery, carbon, and metals are utilized as the lattice for some exceptionally particular purposes. For instance, pottery is utilized when the material will be presented to high temperatures (eg, heat exchangers) and carbon is utilized for items that are presented to grinding and wear (eg, heading and apparatuses).

1.5 Choosing Materials for the Reinforcement

Despite the fact that glass filaments are by a wide margin the most well-known fortification, many propelled composites presently utilize fine strands of unadulterated carbon. Carbon filaments are a lot more grounded than glass strands, but on the other hand are increasingly costly to deliver. Carbon fiber composites are light just as solid. They are utilized in airplane structures and in outdoor supplies, (for example, golf clubs), and progressively are utilized rather than metals to fix or supplant harmed bones. Much more grounded (and all the more expensive) than carbon strands are strings of boron.

Polymers are not just utilized for the network; they additionally make a decent support material in composites. For instance, Kevlar is a polymer fiber that is tremendously solid and adds strength to a composite. It is utilized as the fortification in composite items that require lightweight and

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solid development (eg, basic body portions of an airplane). Composite materials were not the first use for Kevlar – it was created to supplant steel in spiral tires and is presently utilized in impenetrable vests and caps.

1.6 Choosing the Manufacturing Process

Making an article from a composite material for the most part includes some type of shape. The fortifying material is first set in the shape and afterward semi-fluid grid material is showered or siphoned in to frame the item. Weight might be applied to constrain out any air bubbles, and the shape is then warmed to make the grid set strong. The embellishment procedure is frequently done by hand, yet programmed handling by machines is getting increasingly normal. One of the new techniques is called pultrusion (a term got from the words 'pull' and 'expulsion'). This procedure is perfect for assembling items that are straight and have a steady cross area, for example, connect bars. In many meager structures with complex shapes, for example, bended boards, the composite structure is developed by applying sheets of woven fiber fortification, soaked with the plastic network material, over a fittingly formed base shape. At the point when the board has been worked to a proper thickness, the network material is then relieved.

In many propelled composites, (for example, those utilized in the wing and body boards of airplane), the structure may comprise of a honeycomb of plastic sandwiched between two skins of carbon-fiber strengthened composite material. Such sandwich composites join high quality, and especially twisting solidness, with low weight.

1.7 Advantages of Composites

The benefits of composites over their traditional partners are the capacity to meet different structure prerequisites with noteworthy weight investment funds just as the solidarity to-weight proportion. A few points of interest of composite materials over customary ones are as per the following:

The elasticity of composites is four to multiple times more noteworthy than that of steel or aluminum (contingent upon the fortifications).

- Improved torsional firmness and effect properties.
- Higher weariness perseverance limit (up to 60% of extreme rigidity). 30% - 40% lighter, for instance, a specific aluminum structures intended to the equivalent practical prerequisites.
- Lower inserted vitality contrasted with other auxiliary metallic materials like steel, aluminum and so forth.
- Composites are less loud while in activity and give lower vibration transmission than metals.
- Composites are more flexible than metals and can be custom fitted to meet execution needs and complex plan prerequisites.
- Long-life offer brilliant exhaustion, sway, natural opposition and diminish upkeep.
- Composites appreciate diminished life cycle cost contrasted with metals.
- Composites show brilliant erosion opposition and fire retardancy.
- Improved appearance with smooth surfaces and promptly incorporable fundamental brightening melamine are different qualities of composites.
- Composite parts can dispose of joints/latches, giving part disentanglement and incorporated structure contrasted with traditional metallic parts.

II. LITERATURE SURVEY

This section diagrams a portion of the ongoing reports distributed in the writing of fiber-fortified polymer composites. Polymer composite materials have produced wide enthusiasm for different building fields, especially in aviation, vehicle applications. Research is in progress worldwide to create more up to date composites with changed mixes of strands and fillers in order to make them useable under various operational conditions.

The improved presentation of polymer composites in building applications by the expansion of filler materials has indicated an incredible guarantee thus has gotten a subject of significant intrigue. Fired filled polymer composites have been the subject of broad research over the most recent two decades. Molecule fortified composites are competitor materials for a wide assortment of aviation and non-aviation applications.

Different sorts of polymers and polymer grid composites fortified with earthenware particles have a wide scope of mechanical applications, for example, radiators, cathodes, composites with warm solidness at high temperatures, and so on. As of late, it has been seen that by consolidating filler particles into the grid of fiber-fortified composites, synergistic impacts might be accomplished as higher modulus and diminished material expenses, yet joined by diminished quality and effect durability.

The diary - Glass-metal particulate composites by D Chakravorty of Central Glass and Ceramic Institute, Calcutta portrays oxide glasses containing ultra-fine metal particles have intriguing physical properties and have been generally utilized in functional frameworks [1].

Glasses containing ferromagnetic metal grains show a super paramagnetic conduct with a change temperature underneath 300 K. Improvement in the mechanical properties

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of glasses can be accomplished by fusing metal particles of reasonable qualities inside them.

The diary - Effects of molecule size, molecule/framework interface bond and molecule stacking on mechanical properties of particulate–polymer composites by Shao-Yun Fu of Technical Institute of Physics and Chemistry, Chinese Academy of Sciences, Xi-Qiao Feng of FML, Department of Engineering Mechanics, Tsinghua University, Bernd Lauke of Leibniz-Institute of Polymer Research, Germany, Yiu-Wing Mai of Center for Advanced Materials Technology (CAMT), School of Aerospace, The University of Sydney depicts that Particulate–polymer nano composites containing fillers with little perspective proportions are likewise a significant class of polymer composites [2].

There have been various survey papers on layered silicate and carbon nano tube fortified polymer nano composites, in which the fillers have high angle proportions. Point by point conversations on the impacts of molecule size, molecule/framework interface grip and molecule stacking on the solidness, quality, and strength of such particulate–polymer composites were looked into. To grow superior particulate composites, it is important to have some essential comprehension of the hardening, fortifying and toughening components of these composites. So a basic assessment of distributed exploratory outcomes in examination with hypothetical models was given in the diary.

The diary - Powder metallurgy course underway of aluminum combination lattice particulate composites by ALRASHED of Institute of Chemical Technology Prague, Czech Republic depicts the metal lattice composites dependent on aluminum compounds were created by powder metallurgy course, including unidirectional hot squeezing under 500 MPa for 15 minutes at temperature about 0.95 Ts [Solidus Temperature]. Metal lattice contains distinctive weight percents of SiC, AI2O3, WC and Si3N4, with various molecule size[3]. Wear and mechanical tests were completed on composites, and it was discovered that about 90% of wear decrease happened in the composite with 30% Sic contrasted and squeezed lattice.

III. MATERIALS AND METHODOLOGY

3.1 Materials

This chapter describes the details of processing of the composites and the experimental procedures followed for their characterization and evaluation. The raw materials used in this work are:

a) Fiber: E-Glass Fibre (alumino-borosilicate glass with less than 1 wt% alkali oxides, mainly used for glass- reinforced plastics)
b) Particulate: Titanium Di Oxide
c) Resin: Unsaturated Polyester Resin
d) Accelerator: Ethyl Methyl Ketone
e) Catalyst: Cobalt (II) Naphthenate
f) Fiber: E-glass Fiber is commercially used fibers because of its low cost, high productive rates, good chemical resistance and high density compared to Carbon fibers and organic fibers.
g) Particulate: Molecule fillers are generally used to improve the properties of grid materials, for example, to alter the warm and electrical conductivities, improve execution at raised temperatures, lessen grating, increment wear and scraped spot obstruction, improve machinability, increment surface hardness and diminish shrinkage.

TABLE 1
Properties of Titanium Di-Oxide

Properties	
Molecular formula	TiO_2
Molar mass	79.866 g/mol
Appearance	White solid
Density	4.23 g/cm^3
Melting point	1843 °C
Boiling point	2972 °C
Refractive index (nD)	2.488 (anatase) 2.583 (brookite) 2.609 (rutile)

h) Polyester Resin: Polyester sap is unsaturated tars shaped by the response of dibasic natural acids and polyhydric alcohols. Polyesters gums are utilized in sheet shaping compound, mass trim compound and the toner of laser printers. Unsaturated polyesters are buildup polymers framed by the response of polyols (otherwise called polyhydric alcohols), natural mixes with different liquor or hydroxy useful gatherings.
i) Accelerator: Quickening agent is a substance that builds the pace of a compound response. Most compound responses can be rushed with a quickening agent. Accelerants are impetuses that change a substance bond, accelerate a concoction procedure, or take living beings back to homeostasis. Butanone, otherwise called methyl ethyl ketone or MEK, is a natural compound with the equation CH3C(O)CH2CH3. This vapid fluid ketone has a sharp, sweet scent suggestive of butterscotch and CH3)2CO. It is the antecedent to methyl ethyl ketone peroxide, an impetus for some polymerization responses.
j) Catalyst: Catalysis is the procedure wherein the pace of a concoction response is changed by a substance known as an impetus. The impetus may partake in various substance changes. Impetuses that speed the response are called positive

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impetuses. Impetuses that hinder the response are called negative impetuses or inhibitors. The impetus utilized here is cobalt (ii) naphthenate.

3.2 Methodology

Before starting the testing, the specimen must be prepared and all the steps for the preparation of E-glass fiber reinforced unsaturated polyester composites are shown by the following steps:

step 1: Collection of E-glass fiber, accelerator and particulate.
step 2: Mould preparation.
step 3: Mixing the Unsaturated polyester resin and accelerator with a ratio of 1:1.5.
step 4: Preparation of the specimen.
step 5: Various testing (Tensile, impact, hardness, chemical and thermal).
step 6: Results and Discussion.

3.3 Processing of the Composites

An electronically worked steady temperature shower was utilized to circle water through the twofold walled estimating cell made up of steel containing the exploratory arrangement at the ideal temperature. The exactness in the temperature estimation is ± 0.01K.

3.3.1 Specimen Preparation

Before the Unsaturated Polyester Resin is laid upon the shape, the form ought to be very much cleaned and dry. Hence, a discharge specialist like wax clean is laid upon the shape. E-glass fiber is laid into the fiber form. The Unsaturated Polyester Resin is blended in with accelerator (1.5%wt) and catalyst (1.5%wt). The particulate is added to this blend and mixed well. Utilizing a unique brush, Unsaturated Polyester sap blend is laid up consistently on to the form.

TABLE 2
Various composition of Fiber Reinforced Polymer Composites

S .NO	FIBER (%)	RESIN(%)	PARTICULATE (%)
1	10	80	10
2	20	70	10
3	30	60	10
4	40	50	10
5	50	40	10

Composites of five distinct creations, for example, 10%wt, 20%wt, 30%wt, 40%wt, and 50%wt glass fiber are made and the filler content (weight part of TiO_2 in the composite) is kept at 10% for all the examples and the assignments of these composites. The shape is shut and the composite material was squeezed consistently for 24 h for relieving. After the composite filaments are completely dry, at that point it is isolated from the shape. The composite strands are sliced to example sizes prepared for testing. The shape is shut and the composite material was squeezed consistently for24 h for restoring. After the composite filaments are completely dry, at that point it is isolated from the form. The composite filaments are sliced to example sizes of the necessary measurement (20*150 mm2) and are prepared for testing.

IV. CHARACTERIZATION OF THE COMPOSITES

4.1 Tensile Strength

The strain test is for the most part, performed on level examples. The most normally utilized example geometries are the pooch bone example and straight-sided example with end tabs. A uni-hub load is applied through the closures. The ASTM standard test suggests that the examples with strands corresponding to the stacking course ought to be 11.5 mm wide. The length of the test segment ought to be 150 mm.

The test-piece utilized here was of straight-sided example and having measurements as indicated by the principles. The pressure test was performed on all the ten examples.

TABLE 3
Various Rockwell scales

Scale	Abbreviation	Load	Indenter	Use
A	HRA	60kgf	120° diamond cone	Tungsten carbide
B	HRB	100 kgf	1/16 in diameter steel sphere	Aluminium, brass, and soft steels
C	HRC	150 kgf	120° diamond cone	Harder steels
D	HRD	10 kgf	120° diamond cone	
E	HRE	100kgf	1/8 in diameter steel sphere	
F	HRF	60kgf	1/16 in diameter steel sphere	
G	HRG	150kgf	1/16 in diameter steel sphere	

4.2 Hardness

The Rockwell scale is a hardness scale dependent on the space hardness of a material. The Rockwell test decides the

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hardness by estimating the profundity of entrance of an indenter under an enormous burden contrasted with the infiltration made by a preload. There are various scales, which are signified by a solitary letter, that utilization various burdens or indenters. The outcome, which is a dimensionless number, is noted by HRX where X is the scale letter. There are a few elective scales; the most usually utilized being the "B" and "C" scales. Both express hardness as a subjective dimensionless number. The indenter utilized was the 1/8" steel ball.

4.3 Scales and Values

There are several alternative scales; the most commonly used being the "B" and "C" scales. Both express hardness as an arbitrary dimensionless number. The various Rockwell Hardness scales are given in table 3 below.

4.4 Impact Strength

The Charpy sway test, otherwise called the Charpy v-score test, is an institutionalized high strain-rate test which decides the measure of vitality consumed by a material during break. This assimilated vitality is a proportion of a given material's sturdiness.

The mechanical assembly comprises of a pendulum hatchet swinging at a scored test of material. The score in the example influences the aftereffects of the effect test, along these lines it is vital for the indent to be of normal measurements and geometry (2.5 x 45°). The "Standard techniques for Notched Bar Impact Testing of Metallic Materials" can be found in ASTM E23, ISO 148-1 or EN 10045-1. The Charpy sway test was acted in all the ten examples. A graph speaking to the Charpy sway testing (top view) is demonstrated as follows.

4.5 Chemical Resistance

A synthetic test is a subjective or quantitative methodology intended to demonstrate the presence of, or to measure, a concoction compound or substance bunch with the guide of a particular reagent. A possible test is explicitly utilized in clinical science. The synthetic testing was acted in both sulphuric (2N of conc. H_2SO_4) and hydrochloric corrosive (2N of conc.HCL).

The bits of the fiber-strengthened polymer composite were first gauged and afterward submerged in the corrosive for around 24 hours.The pieces were then warmed to a temperature of about 105°C and again gauged.

V. RESULTS AND DISCUSSIONS

5.1 Effect of Fiber and Particulate Loading on the Tensile Strength

The quality of the glass fiber composites relies upon the kind of fiber, lattice, fiber fixation and holding between the fiber and network. The tractable power of the composites was estimated with a mechanized UTM - TIRA at a cross head speed of 50 mm/min. The impact of fiber content on ductile power is appeared in Table 5.1 and Figure 5.1 underneath. It is seen that in all the examples the malleable power of the composite increments with increment in fiber and steady particulate stacking up to 40 wt% and after that it diminished. The quality properties of composite expanded with the steady particulate substance. There can be two purposes behind this expansion in the quality properties of these composites looked at. One chance is that the substance response at the interface between the filler particles and the network might be too solid to even think about transferring the malleable pressure; the other is that at consistent filler content with the expansion in fiber stacking bring about pressure focus in the glass fiber fortified polyester composite. These two variables are liable for an expansion in the elastic power of the composites so remarkably.

TABLE 4
Effect of Fiber and Particulate Loading on the Tensile Force

S. No	% of fiber	Tensile force without particulate(N)	Tensile force with particulate (N)
1	10	2768	3695
2	20	4818	5072
3	30	5411	6829
4	40	7564	7990
5	50	4814	5349

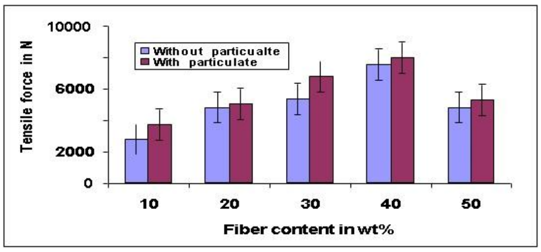

Figure 1: Effect of Fiber and Particulate Loading on the Tensile Force

The strain test is for the most part performed on level examples. The most usually utilized example geometries are the canine bone example and straight-sided example with end tabs. A uni-pivotal burden is applied through the finishes. The ASTM standard test suggests that the examples with filaments corresponding to the stacking course ought to be 11.5 mm wide. The length of the test area ought to be 150 mm. The test-piece utilized here was of straight-sided example and having

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measurements as indicated by the benchmarks. The strain test was performed on all the ten examples.

5.2 Effect of Fiber and Particulate Loading on the Impact Strength

The effect vitality estimations of various composites recorded during the effect tests are given underneath. It demonstrates that the protection from sway stacking of glass unsaturated sap composites improves with an expansion in fiber and particulate stacking as appeared in Figure 2 underneath. High strain rates or effect burdens might be normal in many designing utilizations of composite materials. The reasonableness of a composite for such applications should, accordingly, be resolved by common structure parameters as well as by its effect or vitality engrossing properties. From Fig 3.the portrayal of the composites uncovers that the effect quality properties expanded expanding the fiber and particulate stacking in the composite examples up to 40% wt and after that it diminishes. The level of progress for 30%wt and 40%wt composites was 20.67% and 25.28%.

The Impact Strength and Percentage of improvement (%) can be calculated as mentioned below:

Impact Strength = Observed value / Thickness (J/m).

Percentage of Improvement (%) = ((With particulate – Without particulate)/with Particulate * 100)

TABLE 5

Impact Testing of Fiber Composite Materials

S No.	% of fiber	Impact Strength of composite without particulate. *10^3 J/m	Impact Strength of composite with particulate.	Percentage of improvement (%)
1	10	0.71	0.75	5.63
2	20	1.36	1.543	13.45
3	30	2.66	3.21	20.67
4	40	2.78	3.5	25.28
5	50	5.7	7.1	24.56

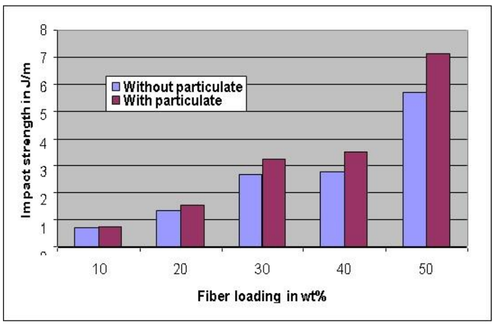

Figure 2: Effect of Fiber and Particulate Loading on the Impact Strength

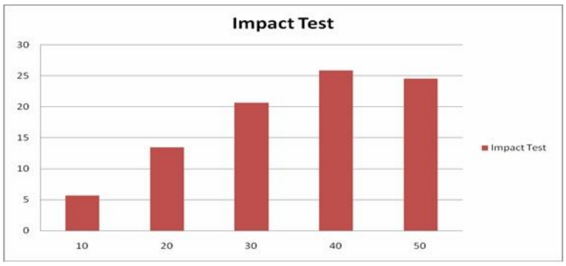

Figure 3: Percentage of Improvement

5.3 Effect of Fiber and Particulate Loading on the Chemical Resistance

The weight loss/gain values of different composites recorded during the chemical tests with HCL / H2SO4 respectively are given in. It shows that the resistance to chemicals of glass unsaturated resin composites improves with increase in fiber and particulate loading as shown in the tables below.

The characterization of the composites reveals that the chemical resistance increased with the increase in the fiber and particulate loading in the composite specimens. The readings are shown in the table below:

TABLE 6

Chemical Testing (HCL) of the fiber Composite without Particulate

Sl No.	% of fiber	Weight before the chemical test (g)	Weight after the chemical test (g)	Weight loss in (g)
1	10	9.503	9.456	0.047
2	20	12.856	12.826	0.03
3	30	9.708	9.664	0.044
4	40	13.343	13.312	0.031
5	50	12.481	12.434	0.047

TABLE 7

Chemical Testing (HCL) of the fiber Composite with Particulate

Sl. No.	% of fiber	Weight before the chemical test (g)	Weight after the chemical test (g)	Weight loss in (g)
1	10	11.53	11.51	0.02
2	20	11.621	11.60	0.021
3	30	12.847	12.814	0.033
4	40	9.464	9.440	0.024
5	50	13.528	13.487	0.045

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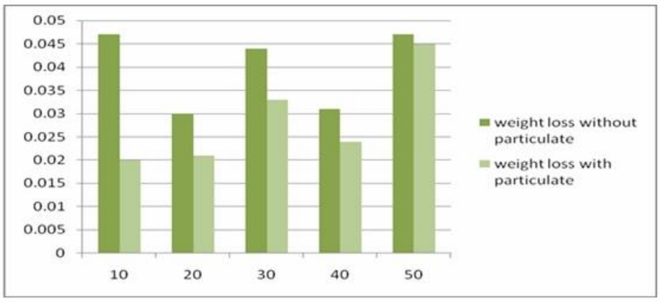


(i.e,. X axis – Fiber loading in %wt, Y axis – weight loss in mg)

Figure 4: Weight Loss in Gms

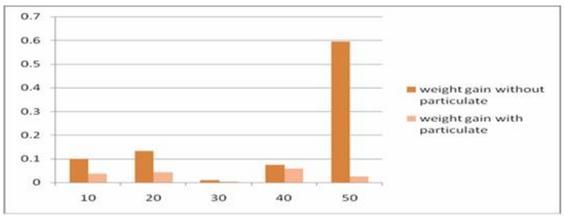
From this graph we infer that weight loss of the samples with particulate is lesser when compared with the weight loss of the samples without particulate in 2N of Conc. HCL solution.

TABLE 8
Chemical Testing (H2SO4) Of the Fiber Composite without Particulate

Sl. No.	% of fiber	Weight before the chemical test (g)	Weight after the chemical test (g)	Weight gain in (g)
1	10	10.295	10.394	0.099
2	20	15.212	15.344	0.132
3	30	12.846	12.856	0.01
4	40	15.222	15.297	0.075
5	50	13.03	13.624	0.594

TABLE 9
Chemical Testing (H2SO4) of the Fiber Composite with Particulate

S No.	% of fiber	Weight before the chemical test (g)	Weight after the chemical test (g)	Weight gain in (g)
1	10	10.369	10.406	0.037
2	20	13.808	13.85	0.042
3	30	14.926	14.929	0.003
4	40	14.555	14.613	0.058
5	50	14.543	14.568	0.025



(i.e,. X axis – fiber loading in %wt, Y axis – weight gain)

Figure 5: Weight Gain in Gms

From this graph we infer that weight gain of the samples with particulate is lesser when compared with the weight gain of the samples without particulate in 2N of Conc. H2SO4 solution. So according to chemical testing, we made a conclusion that it shows highly resist to chemicals.

5.4 Effect of Fiber and Particulate Loading on the Hardness

The hardness is represented by dimensionless number (HRX where X denotes the scale letter).There is several alternative scales of which the C scale is used. The hardness values of different composites recorded are shown in the tabular column below.

TABLE 10
Hardness Testing of Fiber Composite Materials

Sl. No	% of fiber	Hardness without particulate	Hardness with particulate
1	10	HRC53, HRC57 HRC49.5	HRC61, HRC62 HRC62
2	20	HRC49.5, HRC54 HRC50	HRC63, HRC64 HRC64
3	30	HRC51, HRC53 HRC53	HRC65.5, HRC66 HRC66
4	40	HRC55, HRC57.5 HRC58	HRC67, HRC68 HRC68
5	50	HRC59 ,HRC59 HRC61.5	HRC65, HRC63 HRC62.5

The above mentioned values show that the hardness of E-glass fiber reinforced polyester composites increases with the increase in fiber and constant particulate loading.

VI. CONCLUSION

This diagnostic and trial examination concerning the conduct of TiO2 filled E - glass polyester composites are made. The expansion of particulate in the creation of fiber composites makes it fire retardant. A fire retardant is a substance that assists delay with forestalling burning. The fruitful creation of a glass fiber strengthened unsaturated composites loaded up with TiO2 is finished by a straightforward hand lay-up method.

The extra properties, for example, superb synthetic and erosion opposition, high ultra-violet radiation soundness, great warm protection, capacity to weaken sound, scraped spot obstruction, medium-to-high profitability rates can be given by support or potentially framework change, concoction expansion or other definition, material, or creation. As per every one of these properties, it tends to be executed in the utilizations of car motor segments. Likewise, it is seen that there is a critical improvement in the mechanical properties of composites with an expansion in fiber and consistent particulate stacking. The concoction, warm, hardness properties of the composites are additionally incredibly affected by the substance of strands with TiO2 fillers.

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